Office of Food Safety and Shellfish Programs

2000 Annual Inventory:

Commercial & Recreational Shellfish Areas of Puget Sound

May 2001

Washington State Department of Health

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The Department of Health works to improve and protect the health of people in Washington State

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Contents

INTRODUCTION 7

DEFINITIONS AND PROCESS FOR CLASSIFYING COMMERCIAL SHELLFISH GROWING AREAS 8
- Definitions 8
- Process 9

STATUS OF COMMERCIAL SHELLFISH GROWING AREAS 10
- Threatened Shellfish Growing Areas 14
- Fecal Coliform Status and Trends in Commercial Shellfish Beds 14

CLOSURE ZONE DETERMINATIONS 19

SHELLFISH GROWING AREA RESTORATION PROGRAM 20
- Restoration Projects in 2000 20

PUGET SOUND AMBIENT MONITORING PROGRAM 21

LICENSING AND CERTIFICATION PROGRAM 22
- Washington State Shellfish Industry 22

TRIBAL SHELLFISH SANITATION PROGRAM 23

VIBRIO PARAHAEMOLYTICUS IN WASHINGTON STATE 24
- Vibrio Illnesses 25

MARINE BIOTOXIN MONITORING PROGRAM 25
- Commercial PSP Closures 26
- Recreational PSP Closures 27
- Domoic Acid Closures 30
- Summary of PSP Trends Over Time 31

RECREATIONAL SHELLFISH PROGRAM 33
- Consolidated Contracts 33
- High Risk Harvest 34
- Sites Booklet 34
- Beach Classifications 34
- Shellfish Listserv 35

INTRODUCTION

This is the twelfth edition of the *Annual Inventory of Commercial and Recreational Shellfish Areas of Puget Sound* produced by the Washington State Department of Health, Office of Food Safety and Shellfish Programs (DOH). This publication provides important health information about shellfish resources in Puget Sound and contributes to the fulfillment of the Puget Sound Water Quality Management Plan.

The Puget Sound Water Quality Management Plan, administered by the Puget Sound Water Quality Action Team, is the state's strategy for protecting Puget Sound's health — its water quality and its biological resources. The DOH participates with many other agencies to carry out the plan.

Each year we usually publish 12 county maps inside this publication. However, this year we produced a poster size map of the state's shellfish growing areas. The map includes features such as commercial growing area classifications, major streams, sewage treatment plant outfalls and recreational shellfish beach classifications. Comments or suggestions are welcome for future editions. Map information is available in electronic GIS format.

Please contact Wayne Clifford at (360) 236-3307 with any comments or requests for this publication. An electronic copy of this publication can be found on our Internet homepage at www.doh.wa.gov/ehp/sf/.

DEFINITIONS AND PROCESS FOR CLASSIFYING COMMERCIAL SHELLFISH GROWING AREAS

DOH classifies all commercial shellfish growing areas in Washington State as Approved, Conditionally Approved, Restricted, or Prohibited. These classifications have specific standards derived from the National Shellfish Sanitation Program Model Ordinance (Chapter IV, 1999 Revision).

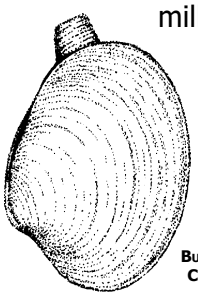
Definitions

Approved

This classification authorizes the harvesting of shellfish for direct marketing. A growing area may be classified as Approved when pollution source evaluations and the bacteriological water quality data show that fecal material, pathogenic microorganisms, and harmful substances are not present in dangerous concentrations.

The bacteriological quality of the marine water samples collected from an Approved growing area must satisfy both parts of the following standard:

1) The concentration of fecal coliform bacteria, the indicator organisms, cannot exceed a geometric mean of 14 per 100 milliliters (ml); and



Butter Clam

2) The estimated 90th percentile cannot exceed 43 organisms per 100 ml, if sampling under the systematic random scheme. If sampling under the adverse pollution condition scheme, not more than 10 percent of the samples can exceed 43 organisms per 100 ml.

Minimums of 30 samples are used for these calculations. The laboratory uses the A-1 modified, 5-tube/3-dilution method to estimate the most probable number (MPN) of fecal coliform bacteria.

Even if the Approved criteria are met for fecal coliform bacteria, DOH may classify a growing area as Conditionally Approved, Restricted, or Prohibited (see definitions below) if pollution source investigations show that contamination may impact the area. Fecal coliform bacteria are good indicators of fresh sewage, but are not always good indicators of the presence of disease-causing viruses and other pathogens. Approved shellfish growing areas are temporarily closed when events such as floods or chemical spills occur or when biotoxin levels exceed the standards.

Conditionally Approved

A growing area that meets Approved criteria only during predictable periods may be classified as Conditionally Approved. For example, in some growing areas DOH has been able to show that in dry weather conditions the fecal coliform criteria are met, but that after rainfall events the criteria are not met. In this situation, DOH temporarily closes the Conditionally Approved growing area after specific rainfall events.

RESTRICTED

If the bacteriological water quality of a commercial growing area does not meet the standard for an Approved classification, but the sanitary survey indicates only a limited degree of pollution that is not primarily from human sources, the area may be classified as Restricted. Shellfish harvested from Restricted growing areas cannot be marketed directly, but must be "relayed" to an Approved growing area for natural biological cleansing. The cleansing period required is generally a few weeks to a few months. Restricted classifications are only considered where levels of pollution, poisonous, or deleterious substances are low enough that relaying will purify the shellfish prior to marketing.

PROHIBITED

A growing area must be classified as Prohibited when information indicates that fecal material, pathogenic microorganisms, and poisonous or deleterious substances may be present in dangerous concentrations. Marine waters adjacent to sewage treatment plant outfalls, marinas, and other persistent or unpredictable pollution sources are classified as Prohibited.

Commercial shellfish harvests are not allowed from Prohibited areas.

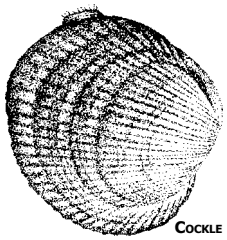
As required under the National Shellfish Sanitation Program, DOH classifies unsurveyed growing areas as Prohibited.

Process

The commercial growing area classification process is called a "sanitary survey" and consists of three parts. These are (1) the "shoreline survey," an investigation of point and nonpoint pollution sources that may impact shellfish sanitation; (2) marine water sampling to determine the fecal coliform bacterial levels in the marine water; and (3) an analysis of meteorological and hydrographic factors that may affect the distribution of pollutants in the area.

During the sanitary survey, point and nonpoint contamination sources are identified and evaluated through field surveys conducted by DOH in cooperation with local health departments, tribes, and the Department of Ecology. Marine water samples are collected to measure the concentration of fecal coliform bacteria in the growing waters. The concentration of fecal coliform bacteria can indicate the presence of pathogens that transmit hepatitis, typhoid, and other diseases to humans. Meteorological and hydrographic information is obtained from other agencies as well as from studies done by DOH.

DOH collects marine water samples throughout the year in all active commercial shellfish growing areas. Shoreline surveys are conducted less frequently, but each year DOH surveys dozens of commercial shellfish growing areas. The National Shellfish Sanitation Program requires that shoreline surveys be carried out in commercial shellfish areas



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at least once every 12 years. During those surveys, all the properties with the potential to impact the growing area water quality are evaluated. Nonpoint sources, such as onsite sewage systems, animal farms, drainage ways and wildlife, are examined. DOH also inspects point sources and establishes closure zones around sewage treatment plants and marinas. Pollution sources needing corrections are referred to the appropriate agencies for action.

The purposes of the shoreline surveys and water quality studies are to ensure that the area complies with the standards associated with its classification, to modify the classification when needed, and to notify the responsible agencies about identified and potential contamination sources. The monitoring data and the reports resulting from these studies are routinely transmitted to local governments and the Department of Ecology. These reports are available to interested parties upon request. For more information contact Bob Woolrich at (360) 236-3329.

Figure 1. 2000 Reclassifications of Intertidal Shellfish Growing Areas

Growing Area	County	Classification	Acreage
Sequim Bay	Clallam	Prohibited to Approved	750
Dungeness Bay	Clallam	Approved to Prohibited	300
Bay Center	Pacific	Conditionally Approved to Approved	690
Henderson Inlet	Thurston	Approved to Prohibited	8
Nisqually Reach	Thurston	Conditionally Approved to Restricted Conditionally Approved to Approved	74 20
Similk Bay	Skagit	Approved to Prohibited	60

In addition to water quality monitoring and shoreline surveys, paralytic shellfish poisoning and domoic acid samples are collected in classified areas on a routine basis. (See section on Marine Biotoxins.)

STATUS OF COMMERCIAL SHELLFISH GROWING AREAS

DOH classifies more than 80 commercial shellfish growing areas in Puget Sound and along the Pacific Coast. Over 200,000 acres are classified as Approved or Conditionally Approved. This acreage does not include subtidal geoduck tracts.

In 2000, DOH reclassified six growing areas. Portions of Dungeness Bay, Henderson Inlet, Nisqually Reach, and Similk Bay were downgraded, and portions of Sequim Bay and Bay Center were upgraded. Figure 1 shows the reclassifications of intertidal shellfish growing areas done in 2000.

Since 1981, DOH has downgraded the classification of about 48,000 acres as the result of declines in sanitary conditions, but has upgraded only about 14,000 acres. In the 1980s, DOH downgraded the classification of almost 33,000 acres, but upgraded only about 1,000 acres. However, since 1990, the total acres upgraded and downgraded were nearly equal. These classification changes are shown in Figure 2.

Figure 2. Commercial Shellfish Growing Area Reclassifications Since 1981

	Classification Downgrades				Classification Upgrades			
Growing Area	**Year**	**Change**	**Acres**	**Reason**	**Year**	**Change**	**Acres**	**Reason**
Bay Center (Pacific Co.)	11/89	Approved to Prohibited	1,590	Rural nonpoint	9/92	Prohibited to Conditionally Approved	1,030	Improvement in shoreline conditions
					10/99	Conditionally Approved to Approved	340	Improved water quality results
					6/00	Conditionally Approved to Approved	690	Improved water quality results
Burley Lagoon (Pierce Co.)	1981	Approved to Restricted	210	Rural nonpoint	10/93	Restricted to Conditionally Approved	210	Correction of sewage system failures and agricultural waste problems
	1/99	Conditionally Approved to Restricted	210	Rural nonpoint	1/99	Prohibited to Restricted	20	Administrative change only
Chico Bay / Dyes Inlet (Kitsap Co.)					12/93	Prohibited to Restricted	150	Reevaluation of point sources
Dosewallips (Jeff. Co.)	9/87	Approved to Restricted	180	Marine mammals (seals)	4/94	Restricted to Approved	30	Seal access to shoreline area was restricted
Drayton Harbor (What. Co.)	1988	Approved to Prohibited	620	Rural nonpoint				
	1/95	Approved to Restricted	30	Point source and rural nonpoint				
	1/95	Approved to Prohibited	1,010	Point source and rural nonpoint				
	9/99	Approved to Prohibited	920	Various point and nonpoint pollution sources				
Duckabush (Jeff. Co.)	7/88	Approved to Restricted	630	Rural nonpoint				
Dungeness Bay (Clallam County)	1/00	Approved to Prohibited	300	Area near mouth of river closed due to rural nonpoint pollution				
Eld Inlet (Thurs. Co.)	2/83	Approved to Conditionally Approved	690	Rural nonpoint	2/98	Conditionally Approved to Approved	450	Repair of on-site sewage systems and Improved farm practices
Grays Harbor (Grays Harbor Co.)					11/94	Conditionally Approved to Approved	17,370	Not the result of changes in sanitary conditions, but rather a reevaluation of hydrography.
Hammersley Inlet (Mason Co.)					6/92	Prohibited to Approved	200	Not the result of changes in sanitary conditions, but rather a reevaluation of sewage treatment plant discharge and water quality

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Henderson Inlet (Thurs. Co.)	1984	Approved to Conditionally Approved	180	Rural nonpoint				
	1985	Conditionally Approved to Prohibited	120	Rural nonpoint				
	9/00	Conditionally Approved to Prohibited	8	Nonpoint				
Liberty Bay (Kitsap Co.)	5/91	Conditionally Approved to Restricted	260	Rural and urban nonpoint	4/94	Restricted to Approved	70 (Lemolo Area)	Correction of on-site sewage system failures and re-evaluation of hydrographics
Lilliwaup Bay (Mason Co.)	7/98	Approved to Prohibited	22	Area failed fecal coliform standard - wildlife most likely cause				
Lower Hood Canal (#9) (Mason Co.)	1987	Approved to Prohibited	630	Rural and urban nonpoint	10/96	Restricted to Approved	530	Correction of on-site sewage system failures
	2/93	Approved to Prohibited	960	Rural nonpoint including on-site sewage system failures	5/98	Prohibited to Approved	400	Repairs of on-site sewage systems
Minter Bay (Pierce Co.)	1982	Approved to Prohibited	60	Rural nonpoint				
Nisqually Reach (Thurs. Co.)	6/92	Approved to Conditionally Approved	2,130	Rural nonpoint				
	9/00	Conditionally Approved to Restricted	74	Rural nonpoint	9/00	Conditionally Approved to Approved	20	Improved water quality results
North Bay (Mason County)	5/91	Approved to Prohibited	1,260	On-site sewage system failures	10/91	Prohibited to Conditionally Approved	450	Correction of on-site sewage system failures
					6/92	Prohibited to Conditionally Approved	710	Correction of on-site sewage system failures
					10/92	Prohibited to Restricted	100	Correction of on-site sewage system failures
North River (Pacific County)					7/98	Prohibited to Approved	900	On-site systems discharging to Willapa River connected to sewer
Oakland Bay (Mason Co.)	2/87	Conditionally Approved to Restricted	1,380	Urban point and nonpoint	4/89	Restricted to Conditionally Approved	1,380	Improvement in water quality
Penn Cove (Island Co.)	1983	Conditionally Approved to Prohibited	500	Sewage treatment plant	1/95	Prohibited to Conditionally Approved	450	Sewage treatment plant and nonpoint source improvements
Port Gamble Bay (Kitsap Co.)	7/96	Approved to Prohibited	20	Rural nonpoint	3/99	Prohibited to Approved	20	Rural nonpoint sources corrected

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Port Susan (Snoh. & Island Co.)	5/87	Approved to Restricted	11,900	Agricultural nonpoint/sewage treatment plant				
Portage Bay (What. Co.)	8/97	Approved to Restricted	60	Rural nonpoint				
	9/99	Approved to Restricted	90	Rural nonpoint				
Quilcene Bay (Jeff. Co.)	1984	Approved to Prohibited	200	Rural nonpoint				
Rocky Bay (Mason Co.)	8/95	Approved to Prohibited	30	Rural nonpoint				
Samish Bay (Skagit Co.)	8/94	Approved to Restricted	490	Agricultural, rural nonpoint including on-site sewage system failures				
	8/94	Approved to Prohibited	2,200	Agricultural, rural nonpoint including on-site sewage system failures	5/98	Restricted to Approved and Prohibited to Conditionally Approved	835	Repair of sewage problems in near shore communities
Sequim Bay (Clallam Co.)	2/92	Approved to Prohibited	200	Sewage treatment plant				
	2/92	Approved to Conditionally Approved	2,830	Sewage treatment plant	6/98	Conditionally Approved to Approved	2800	Sewage treatment plant upgrade and relocation of outfall
Similk Bay (Skagit Co.)	7/00	Approved to Prohibited	60	Failing on-site sewage systems				
Skagit Bay South (Skagit Co.)	3/87	Approved to Restricted	6,140	Rural, agricultural nonpoint	9/93	Restricted to Conditionally Approved	2,280	Sewage treatment plant performance and correction of agricultural waste problems
Skagit Bay North (Skagit Co.)	3/89	Approved to Restricted	9,540	Rural nonpoint				
Squaxin Island (Mason Co.)					7/93	Prohibited & Conditionally Approved to Approved	50	Removal of boat dock and mooring buoys

Threatened Shellfish Growing Areas

Each spring DOH releases a list of shellfish growing areas threatened with downgrades in classification. These areas marginally meet their classification or have deteriorating sanitary conditions. Criteria that were used to identify areas for the March 2001 threatened area list include:

- Water station(s) with a ninetieth percentile between 30 and 43 fecal coliforms per 100 ml.
- Water stations where 6 to 10 percent of the water sample results are greater than 43 fecal coliforms per 100 ml.
- Pollution source problems identified within the watershed and/or along the shoreline that threaten the classification.

The idea behind releasing the list is to alert growers, tribes, and other agencies to the marginal status of these growing areas. It also provides opportunities for local governments and the Department of Ecology to correct pollution problems before DOH has to close an area or downgrade its classification.

The list and associated reports are sent to the Puget Sound Action Team, the Pacific Coast Shellfish Growers Association, the Northwest Indian Fisheries Commission, the Department of Ecology, and the Puget Sound Council. In addition, county-by-county reports are sent to the local health departments and individual growing area reports to shellfish growers who harvest in areas identified as threatened with a downgrade or failing to meet standards.

Downgrades in classification are bad news. They affect shellfish businesses by either restricting or eliminating harvesting. When an area is downgraded due to nonpoint pollution, RCW 90.72 requires local governments to form shellfish protection districts to address the problem.

Figure 3 shows the areas on the March 2001 threatened area list. They include:

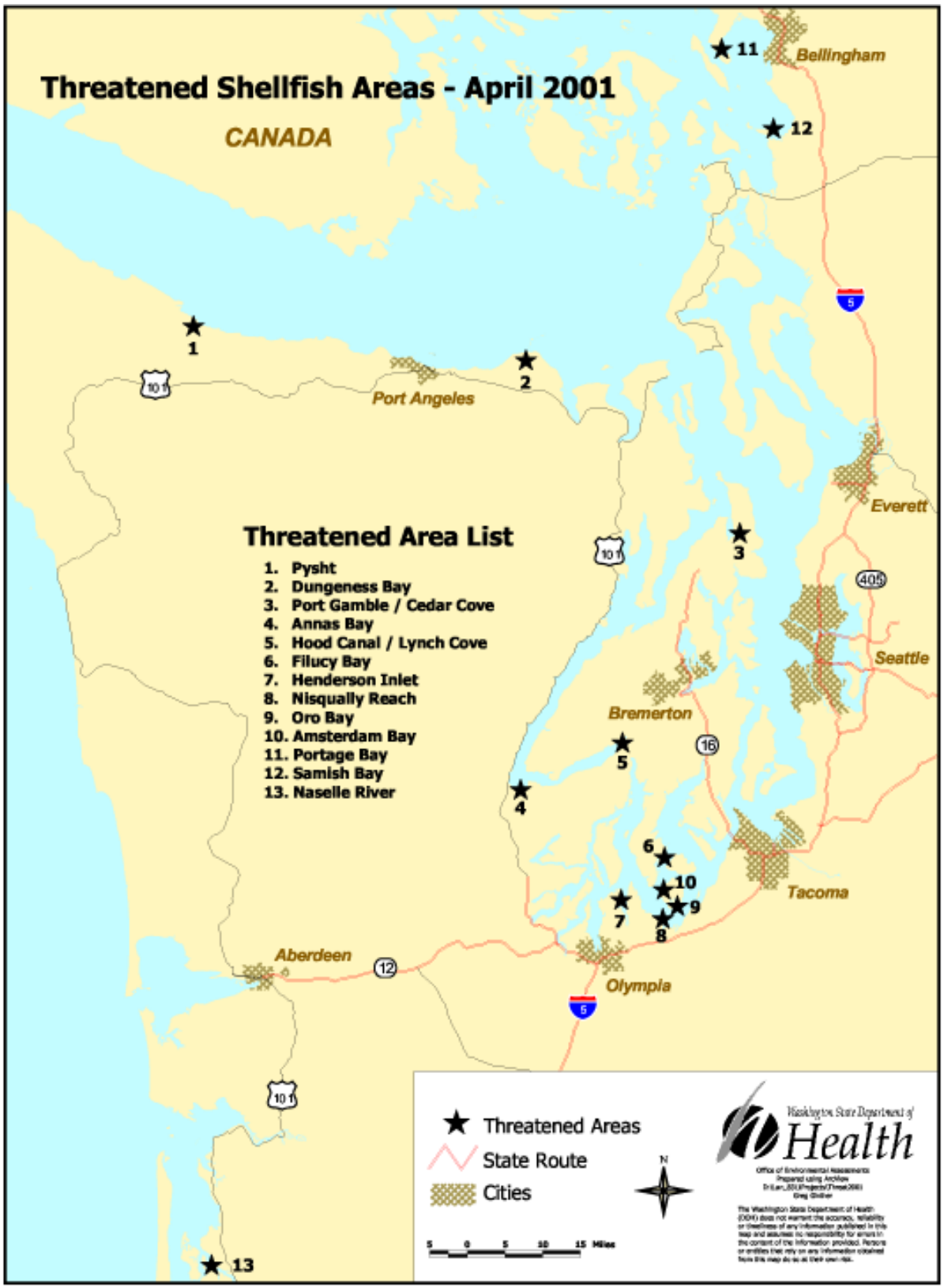
- Dungeness Bay (Clallam County)
- Pysht (Clallam County)
- Port Gamble / Cedar Cove (Kitsap County)
- Annas Bay (Mason County)
- Lynch Cove (Mason County)
- Naselle River (Pacific County)
- Amsterdam Bay (Pierce County)
- Filucy Bay (Pierce County)
- Oro Bay (Pierce County)
- Samish Bay (Skagit County)
- Henderson Inlet (Thurston County)
- Nisqually Reach (Thurston County)
- Portage Bay (Whatcom County)

Harvest restrictions are pending in parts of four of the threatened areas, including Henderson Inlet, Filucy Bay, Dungeness Bay, and Oro Bay. For more information, contact Bob Woolrich at (360) 236-3329.

Fecal Coliform Status and Trends in Commercial Shellfish Beds

DOH participates in the Puget Sound Ambient Monitoring Program (PSAMP), a multi-agency team that analyzes various data related to the health of Puget Sound. In 2000 DOH determined fecal pollution status and trends in growing areas throughout Puget Sound. The

Figure 3. Threatened Shellfish Growing Areas



growing areas in Puget Sound were sorted into two groups: Core Areas and Rotational Areas.

Core Areas

Core areas are assessed annually because of intensive shellfish harvest over many years, a history of pollution impact, active remedial action programs, and abundant data. Core areas are distributed throughout Puget Sound.

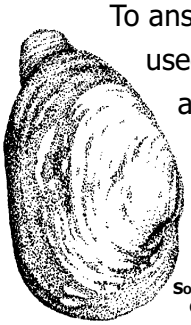
Rotational areas

Rotational areas are generally located in remote locations with minimal pollution. They are divided among three Puget Sound regions. Areas in each of the three regions are assessed at three-year intervals. The central region (Hood Canal, Admiralty Inlet, and Main Basin Puget Sound) were assessed in 2000.

PSAMP analyses address two questions (see Puget Sound Ambient Monitoring Program section for more information on PSAMP):

- What is the status of fecal coliform contamination relative to DOH's standards and guidelines?

- Have levels of fecal coliform bacteria changed over time?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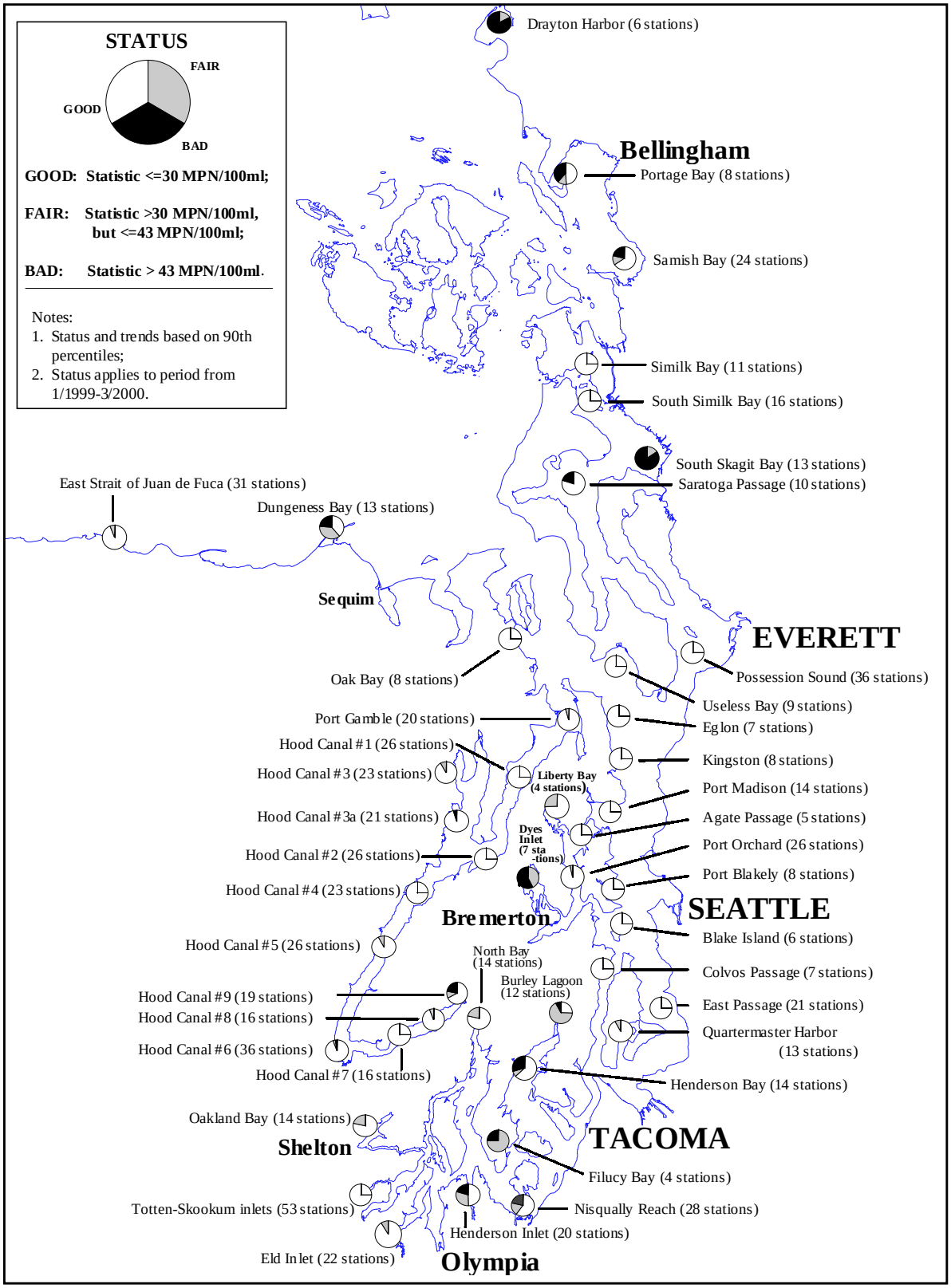
To answer these questions, statistics used by DOH to classify growing areas (geometric means and 90th percentiles) were calculated for each sampling date starting from the earliest date possessing the minimum of 30 prior samplings forward to the most recent date possible. The PSAMP procedure is similar to the initial steps used to classify a growing area (see *Process* section on page 8). However, the classification process usually requires additional data handling and calculations beyond that needed to address PSAMP goals.

Status of fecal coliform in shellfish growing areas

Over 700 stations in 43 growing areas were assessed for PSAMP in 2000. The extent of pollution in each growing area (or collection of areas) is summarized by pie charts in figure 4. The size of each piece of pie represents the percentage of stations falling into each of three categories (good, fair, and bad) during the period of Jan. 1999 to Mar. 2000. A station was labeled *good* if 90th percentiles calculated for all dates within the period were below the "early-warning" threshold of 30 fecal coliform per 100ml (see *Threatened Area* section on page 14 for more information on the early warning system). A station was *fair* if one or more ninetieth percentiles exceeded the *early-warning* threshold, but none exceeded the 90th percentile limit of 43 fecal coliforms (FC) per 100ml limit set by the National Shellfish Sanitation Program (NSSP). If one or more 90th percentiles were above the NSSP limit during the period, the station was deemed *bad*. Some stations and growing areas in this analysis are located in prohibited areas.

Figure 4. Status of water quality stations in selected shellfish growing areas in Puget Sound



Sampling stations in 4 of 11 areas in Hood Canal were good; 3 areas had at least 1 fair station and 4 had 1 or more bad sites. 10 of 14 areas in Admiralty Inlet and Main Basin Puget Sound were good; 3 areas had at least 1 fair station and 1 had 1 or more bad sites. Only 1 area of 9 in South Puget Sound had all good stations. Three areas had at least 1 fair station and 5 had 1 or more bad sites. Figure 5 ranks 26 of 43 areas with 1 or more sites categorized as fair and/or bad according to a fecal pollution impact index developed for PSAMP. The most contaminated growing areas were Drayton Harbor and South Skagit Bay, followed by Dyes Inlet (Chico Bay) and Filucy and Portage bays.

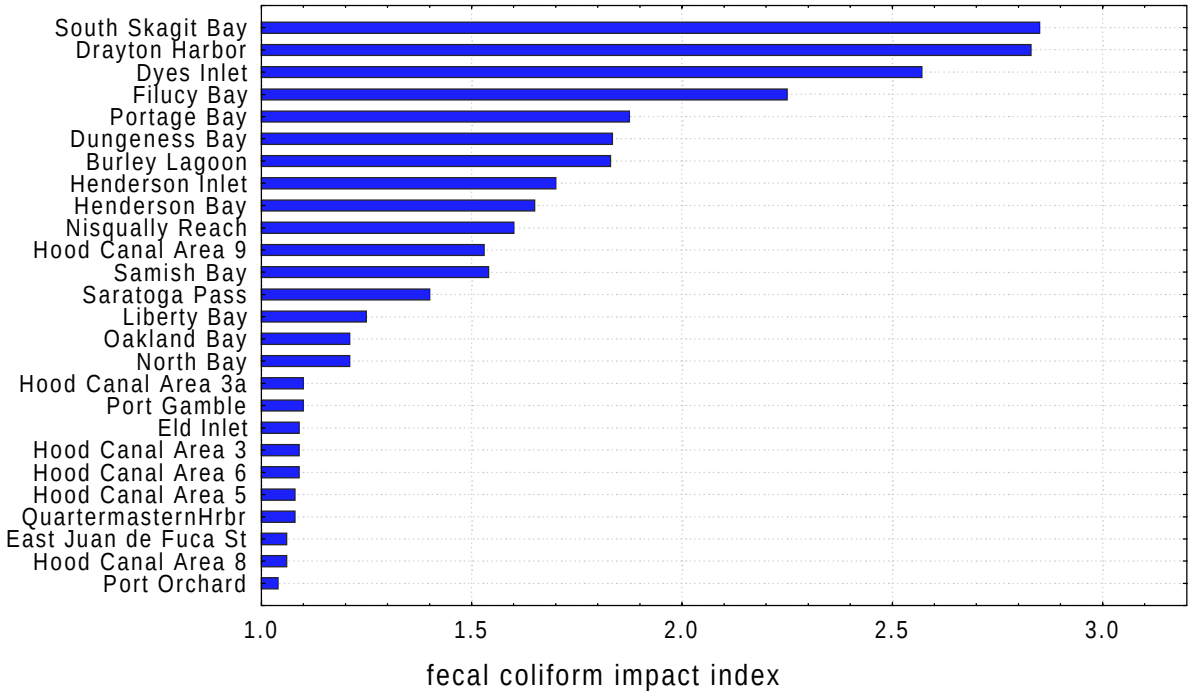
Likely pollution sources in all areas include failing onsite sewage systems and pasture drainage from upland watersheds. Oakland Bay and Drayton Harbor were likely influenced by contaminated urban storm water. Drayton Harbor may also receive sewage discharged from boats. Fecal pollution in Portage Bay appeared to be drainage from livestock operations along the Nooksack River.

Trends in fecal pollution

Trends were determined at 225 stations in 26 growing areas when history of sampling and level of pollution were sufficient to warrant it. Trends were not done on the rest because they had very short sampling records (less than three years) or very low statistics (i.e., 90th percentiles were always less than 10 FC per 100ml).

Almost half (46%) of the "trend" stations showed increasing fecal pollution. Growing areas dominated by worsening stations included Henderson Inlet (18 of 20 stations),

Figure 5. Fecal Pollution Impact Index



Dungeness and south Skagit bays (11 of 13 stations each), and Burley Lagoon (8 of 12 stations). The remaining stations were equally split between improving and unchanged (27% each). Areas with decreased fecal pollution included Oakland Bay, Eld Inlet, and North Bay.

The apparent reduction in fecal pollution in Oakland Bay and Eld Inlet may be due, in large part, to focused corrective action programs. Improvements in the Shelton Sewer system may explain improving conditions in Oakland Bay. In Eld Inlet, repair of many failed individual onsite sewage systems correlated well with reduced fecal contamination at nearby DOH stations. For more information on trends in fecal coliform contact Tim Determan (360) 236-3311.

CLOSURE ZONE DETERMINATIONS

Shellfish are filter feeders, and they can accumulate and concentrate nearby disease-causing organisms. Therefore it is important that the public be protected from consuming shellfish located near actual and potential sources of pollution. Closure zones are established by DOH around sources of possible pollution to prevent harvest and consumption of potentially contaminated shellfish. Typical sources are sewage treatment plants, marinas, and nonpoint sources such as river discharges or runoff from watersheds following heavy rainfall. For example, there are more than five dozen sewage treatment plant outfalls discharging to the marine waters of the state, some near shellfish growing areas. The daily discharge from these treatment plants varies greatly, from tens of thousands of gallons at small plants to over one hundred million gallons at the largest facilities.

DOH conducts a technical evaluation for each sewage treatment plant and marina located near an area of commercial or public recreational shellfish harvest. Evaluations for each potential pollution source include inspecting the facility by the DOH engineer, gathering information on water currents and characteristics near the site, and evaluating the dilution and dispersion of any wastewater discharged from the facilities. Frequently DOH conducts its own studies to better understand the movements of marine waters in the area if such information is not available, or works with the consultants of these facilities to generate the information. DOH studies can include the measurement of dye injected into a treatment plant's discharge by boat-mounted equipment, and the use of fix-depth floats to study the dilution, current speed and direction in the nearby marine waters. DOH uses this information collected at marinas and sewage treatment plants in computer models to calculate the size of closure zone for each facility, using the conservative assumption that an unplanned upset event or waste discharge has occurred. In addition, each sewage treatment plant is required to call DOH immediately if a bypass occurs, or if a problem occurs with the disinfection system. In turn, DOH closes the designated area near a pollution discharge event to commercial and public recreational shellfish harvesting and contacts stakeholders

such as county health departments, tribal and non-tribal shellfish harvesters, and the Washington State Department of Fish and Wildlife. Using this approach, the public is protected from consuming contaminated shellfish near potential pollution sources, even during unusual conditions. For more information contact Frank Meriwether at (360) 236-3321.

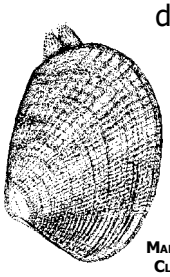
SHELLFISH GROWING AREA RESTORATION PROGRAM

The goal of the DOH Restoration Program is to reopen commercial and recreational shellfish beds that have been closed or reclassified and to prevent the closure of shellfish areas that are still open but threatened. The Restoration Program works cooperatively with entities such as the Puget Sound Water Quality Action Team, Department of Ecology, tribes, and local governments. Program activities include water quality testing, participating in surveys to identify pollution sources, serving as a member or advisor on watershed committees, and assisting in the development of watershed management plans and closure response plans.

Restoration Projects in 2000

Dungeness Bay (Clallam County)

Three hundred acres in Dungeness Bay were downgraded from approved to prohibited in 2000. Restoration Program personnel are working with county, state, tribal and federal agencies to identify and correct the pollution sources responsible for the downgrade.



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Henderson Inlet (Thurston County)

A one-acre parcel of tidelands in the prohibited area was upgraded to approved. Nine acres in the conditionally approved portion of Henderson Inlet were downgraded to prohibited in 2000. Restoration Program personnel are working with county and state agencies to identify and correct the pollution sources responsible for the downgrade. A closure response plan has been developed.

Nisqually Reach (Thurston County)

Seventy-four acres in the conditionally approved portion of the Nisqually Delta were downgraded to restricted in 2000. Restoration Program personnel are working with county, state, tribal and federal agencies to identify and correct the pollution sources responsible for the downgrade. A closure response plan has been developed.

Lower Hood Canal (Mason County)

DOH and Mason County are continuing efforts in the Lower Hood Canal prohibited area to identify the source or sources of pollution responsible for the elevated levels of fecal coliform bacteria. Dye is being inserted in onsite sewage systems to identify failures.

Portage Bay (Whatcom County)

Restoration Program personnel are working with the Lummi Nation, Whatcom County, state, and federal agencies to identify and correct the pollution sources in the Nooksack watershed responsible for the downgrades in 1997 and 1999. DOH is monitoring the area monthly.

Burley Lagoon (Pierce and Kitsap Counties)
Restoration Program personnel are working with agencies of the two counties involved in the Shellfish Protection District along with the Puget Sound Action Team to identify and correct the pollution sources responsible for the 1999 downgrade. DOH is monitoring this area monthly.

Drayton Harbor (Whatcom County)
Restoration Program personnel continue to work with various agencies of the City of Blaine, Whatcom County, Washington State, and the Watershed Committee to identify and correct the pollution sources responsible for the downgrades in 1988, 1995, and 1999. The area is classified entirely as prohibited, but DOH is continuing to monitor it.

Samish Bay (Skagit County)
Restoration Program personnel are working with Skagit County agencies to identify and correct the pollution sources responsible for the 1994 downgrade, while continuing the process which resulted in the 1998 upgrade of a portion of the bay.

Rocky Bay (Pierce County)
Restoration Program personnel are working with Pierce County agencies and the local citizens watershed committee to identify and correct the pollution sources responsible for the 1995 downgrade.

Port Susan (Snohomish County)
Restoration Program personnel continue to work with the Stillaguamish Tribe and Snohomish County agencies to identify and correct the pollution sources in the Stillaguamish watershed responsible for the 1987 downgrade.

Similk Bay (Skagit County)
Skagit County Health Department has begun placing dye into onsite sewage systems to identify failures. DOH continues to monitor the marine waters and participate in the closure response process.

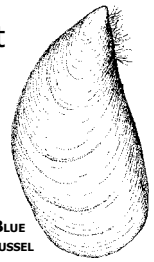
For further information on the Restoration Program, contact Don Melvin at (360) 236-3320.

PUGET SOUND AMBIENT MONITORING PROGRAM

The Department of Health Office of Food Safety and Shellfish Programs participates in the Puget Sound Ambient Monitoring Program (PSAMP). The goals of PSAMP are to:

- Assess the health of Puget Sound and its resources;
- Identify existing environmental problems;
- Provide data to help the Puget Sound Water Quality Action Team and others measure the success of environmental programs;
- Provide a permanent temporal record of significant natural and human-caused changes in key environmental indicators in Puget Sound; and
- Support research activities by making available scientifically valid data.

The primary goal of DOH is to assure the health and safety of shellfish consumers. Information gathered by DOH programs can also be used to meet the broader goals of PSAMP.


BLUE MUSSEL

Data are drawn from two office programs: the Biotoxin Monitoring Program and the Commercial Areas Water Quality Monitoring Program. In recent years these data have been analyzed for PSAMP and publicly presented through several channels, including DOH technical reports, publications of the Puget Sound Water Quality Action Team (Puget Sound Update, Soundwaves), posters and demonstrations at regional fairs, and presentations at scientific meetings (1998 Pacific Estuarine Research Society meeting, 1998 Puget Sound Research symposium, 1998 Pacific Rim Shellfish meeting).

Summaries of the 2000 PSAMP analyses are contained in this report as parts of Fecal Coliform Status and Trends in Commercial Shellfish Beds (pages 16-19) and Marine Biotoxin Monitoring Program (pages 32-33).

LICENSING AND CERTIFICATION PROGRAM

DOH's Shellfish Licensing and Inspection Program is a statewide program designed to protect the public health by licensing and certifying all commercial shellfish companies in Washington state. This program ensures that standards are met in the handling, processing, packaging, buying, storage and distribution of shellfish. Through a formal agreement with the Department of Fish and Wildlife, shellfish growing areas are monitored to prevent the illegal harvest of shellfish from unsafe, polluted waters.

PACIFIC OYSTER

Washington State Shellfish Industry

Washington State is among the top shellfish producing states in the nation, and is recognized as having one of the nation's safest supplies of shellfish. The success in assuring that Washington shellfish are among the safest in the nation is due, in part, to the cooperative efforts of DOH, the Washington Tribes and the shellfish industry.

The commercial shellfish licensing year runs from October 1 through November 30 each year. The Washington state shellfish industry currently consists of approximately 343 licensed, certified shellfish operations. Approximately 26 firms are licensed as *shucker-packers* (shellfish processing firms), and over 200 are licensed as *shellstock-shippers*. More than 115 firms are licensed as *harvesters*. DOH performed almost 600 inspections of licensed shellfish operations during the 1999-2000 license year.

Shucker-Packers

Shucker-packer firms either harvest or purchase shellstock, then process it in their plants by shucking, washing, and packing the meats for sale to retail markets. These processing plants are inspected for shellfish sanitation and safety an average of four times a year. DOH performed 100 inspections on shucker-packer firms during the October 1999 - November 2000 license year.

Shellstock-Shippers

Shellstock-shipper firms either harvest or purchase shellstock for direct sale to retail markets or to other shellfish dealers. Their licenses are limited to the sale of shellstock (unshucked shellfish) only; these firms are not permitted to shuck shellfish. Shellstock-shipper firms are inspected an average of 2-times per year. DOH performed 375 inspections on shellstock-shipper firms during the 1999-2000 license year.

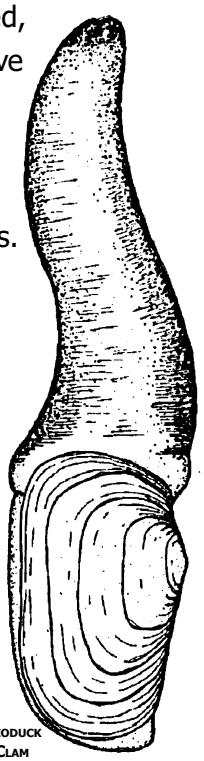
Harvesters

Harvester firms are limited to harvesting shellstock and selling it intrastate (only within the state of Washington) to licensed shucker-packer firms or shellstock-shipper firms. They are not permitted to purchase shellstock, nor sell it to retail. Harvesters are not permitted to shuck shellfish, repack shucked shellfish, repack shellstock, or store shellstock. Harvester operations are inspected once per license year. DOH performed 122 inspections on harvester firms during the 1999-2000 license year. For further information contact Judy Dowell at (360) 236-3313.

TRIBAL SHELLFISH SANITATION PROGRAM

2000 began the seventh year of the Tribal Shellfish Sanitation Program when the U.S. v. Washington shellfish subproceeding commenced in the United States District Court of Western Washington. Progress has been made in establishing and maintaining a cooperative program with the tribes and DOH. Currently, 14 treaty tribes are certified by DOH. Those certified as harvesters are the Makah Tribe, the Nisqually Tribe, the Puyallup Tribe, and the Squaxin Island Tribe. Those certified as interstate shellstock shippers are the Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Lummi Indian Nation, Muckleshoot Tribe, Port Gamble S'Klallam Tribe, Skokomish Tribe, Suquamish Tribe, the Tulalip Tribes, and the Skagit System Cooperative. Three tribes - the Upper Skagit Tribe, Sauk-Suiattle Tribe, and Swinomish Tribe - make up the Skagit System Cooperative. The Quinault Indian Nation and the Squaxin Island Tribe have certified shucker packer operations. There are 35 individual tribal members who have applied for and received shellfish certifications.

Ongoing DOH/Tribal quarterly technical meetings have continued the joint cooperation in protecting public health. These meetings have produced some draft protocols, which include the harvest of wild seed, the harvest of molluscan bivalve shellfish for bait, and the protection of public health from the harvest and sale of non-molluscan shellfish species. These meetings have focused on adopting these protocols. Other technical issues have arisen such as biotoxin testing for crab and in the visceral ball of the geoduck clam (Panopea generosa). Work is also in progress on the sixth annual list of tribal growing area classification requests, which includes growing



GEODUCK CLAM

areas where tribes desire to harvest shellfish. Before any harvest, each beach or geoduck tract classification request is reviewed using the same requirements as non-tribal requests under the NSSP. Tribal personnel continue to assist with water quality monitoring for this task. Continued development of joint protocols and training are priorities for this program.

Tribal geoduck harvesting operations exist in the Strait of Juan de Fuca, Hood Canal, and central and south Puget Sound. Geoduck boats and product landings are inspected for sanitation and proper handling of commercial product. Tribal monitors and patrol officers are working with DOH to ensure a safe product by enforcing rules for harvesting in open approved areas only. The tribes also supply geoduck for biotoxin sampling, and tribal and non-tribal harvesters share the results of analyses.

Continued cooperation between local health jurisdictions and tribes has been enhanced with consolidated contracts that DOH has managed. Clallam County Department of Health and Human Services and the Jamestown S'Klallam Tribe sample the recreation beach at Jamestown for biotoxins and are working together to look for potential pollution sources in the Dungeness River watershed. The Lummi Indian Nation and Whatcom County Health Department are jointly monitoring the Nooksack River for potential pollution sources. Continued cooperation between local jurisdictions and the tribes is ensuring that shellfish growing areas remain open and approved.

In addition to establishing programs specific to commercial endeavors, cooperative efforts also benefit subsistence and recreational shellfish harvesters. The Quileute Tribe continues to conduct a coastal biotoxin monitoring program funded by the federal government. The tribes contract with DOH's biotoxin laboratory to test for paralytic shellfish poison (PSP) and domoic acid in shellfish collected on several north Pacific coast beaches. The results are shared with all coastal shellfish harvesters. Tribal sampling helped identify that domoic acid levels in razor clams were rising to record levels in 1998.

Overall, tribal involvement continues to result in increased public health protection and awareness of Washington shellfish sanitation issues. For more information, please contact Stan Iwagoshi at (360) 236-3315.

VIBRIO PARAHAEMOLYTICUS IN WASHINGTON STATE

DOH carries out portions of the national *Vibrio parahaemolyticus Interim Control Plan for Oysters*. The control plan was developed through the Interstate Shellfish Sanitation Conference.

Routine shellfish testing is part of the control plan. Figure 6 shows the results of routine sampling of oysters from five representative commercial shellfish growing areas in Washington with significant levels of *Vibrio parahaemolyticus* (V.p.) during the summer of 2000.

Vibrio Illnesses

There were a total of nine confirmed cases of vibriosis linked to Washington molluscan shellfish during 2000. Of these:

- Four cases were linked to commercial product harvested in Washington. These cases were linked to oysters, mussels and manila clams.
- Two cases were linked to recreational product harvested in Washington. These cases were linked to oysters.
- Three cases where linked to products from multisource locations including Washington. These cases were linked to oysters.

There were a total of three confirmed cases of vibriosis connected with out-of-state oysters and clams.

Eight confirmed cases were linked to oysters and clams of unknown origin.

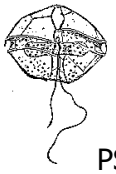
For more information contact Jessie DeLoach at (360) 236-3302.

Figure 6. Significant V.p. Sample Results

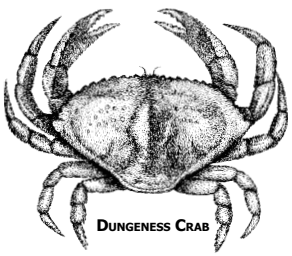
Area	Level	Date
Hood Canal South	110	7/11/00
Totten Inlet	110	7/31/00
Hood Canal South	240	8/7/00
Samish Bay	110	8/7/00
Samish Bay	460	8/14/00
Hood Canal South	430	8/28/00
Hood Canal North	1100	7/25/00
Samish Bay	4600	7/31/00
Little Skookum Inlet	2400	8/14/00

MARINE BIOTOXIN MONITORING PROGRAM

The state of Washington routinely experiences seasonal restrictions on commercial and recreational shellfish harvest due to paralytic shellfish poisoning (PSP), more commonly known as "red tide". The biotoxin that causes PSP temporarily interferes with the transmission of nerve impulses in warmblooded animals. The primary symptoms of PSP in humans are numbness and tingling of the lips, tongue, face and extremities, difficulty talking, breathing, swallowing and muscle incoordination. Symptoms develop quickly, usually within 1-2 hours of consumption (very high levels of toxin can produce symptoms within 30 minutes), and typically disappear within 12-24 hours. There is no known antidote for the toxin and it is not destroyed by cooking. Treatment is basically supportive, i.e., artificial respiration in life threatening cases.



PSP toxin is produced by microscopic organisms that naturally exist in marine water. The species that causes PSP in Washington marine waters is *Alexandrium catenella*. *Alexandrium* is usually present in small numbers; however, when environmental conditions are optimum, rapid reproduction occurs. Filter-feeding shellfish, which include clams, oysters, mussels and scallops, can accumulate the toxin to dangerous levels during these "blooms".



Dungeness Crab

DOH monitors PSP toxin levels in shellfish from areas throughout the state. Commercial operations participate in the PSP program by submitting samples. Recreational beaches are sampled as a cooperative effort between DOH, other state agencies, tribes and local health departments, often utilizing citizen volunteers. Areas are closed for harvest of molluscan shellfish when PSP toxin levels equal or exceed the Food and Drug Administration standard of 80 micrograms (μg) toxin/100 grams shellfish tissue. Areas are not reopened until testing has confirmed that the PSP toxin has declined to a safe level. Butter clams (*Saxidomus giganteus*) may experience extended closures because they typically retain the PSP toxin longer than other shellfish. An annual regulatory closure for all species is in effect for the ocean beaches and the Strait of Juan de Fuca, west of Dungeness Spit from April through October.

A recreational razor clam season may be held each spring and fall depending on biotoxin levels and availability of resource.

DOH maintains a toll free 24-hour "PSP Hotline" at 1-800-562-5632 and posts closures on the internet at www.doh.wa.gov/ehp/sf/. Local health jurisdictions also issue notices through local newspapers and radio. Beach posting is irregular depending on jurisdiction, beach ownership, susceptibility to vandalism and theft, and is not a reliable method of notification.

The Washington State Public Health Laboratory analyzed over 3,700 PSP samples in 2000. The commercial shellfish growers monitored commercial growing areas, biweekly during 2000. Selected recreational beaches were monitored biweekly from April through October by local health jurisdictions, Adopt-a-Beach and other volunteers. Sentinel mussel cage sites were monitored year-round.

Commercial PSP Closures

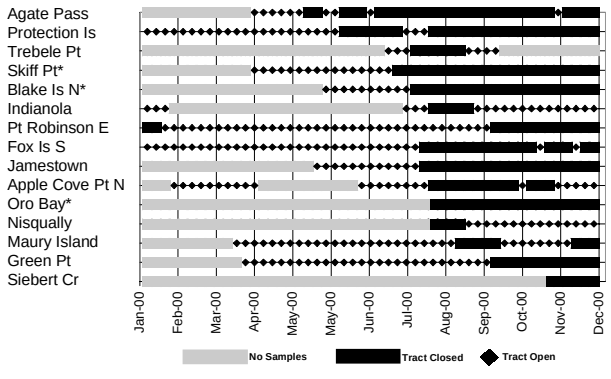
As in the last three years, PSP activity in 2000 in the inland waters of Puget Sound and the Strait of Juan de Fuca did not follow the typical pattern. Perhaps a new "typical pattern" is emerging. One pattern that seems to be repeating itself is the large number of commercial geoduck tract closures. There were a total of 24 geoduck tract closures in 2000, just two less than in 1999. The first geoduck tract closure was in January in King County. This closure, like the January 1999 closure, may have been the result of toxin levels that carried over from the blooms of the previous fall, rather than representing new bloom activity. The majority of the geoduck tract closures in 2000 occurred in the July/ August time period. Figure seven shows the duration of open and closed periods for geoduck tracts.

The first significant PSP bloom in 2000 began in April near the Canadian border. No commercial areas were impacted by this bloom. Starting in June the PSP season began in earnest, closing commercial areas around Bainbridge Island. In July a bloom in the San Juan Islands closed Ship Bay on Orcas Island. At the same time minor blooms impacted Grays Harbor and Willapa Bay, where PSP levels were high enough to activate the

increased sampling contingency plans. However, commercial shellfish toxin levels did not exceed the closure level in these areas.

By August PSP bloom activity in South Puget Sound reached historically significant levels, prompting closures in both commercial areas of Carr Inlet and one commercial area in Filucy Bay. August blooms also occurred in the Olympic Peninsula area of the state, causing commercial closures in Discovery Bay, Neah Bay and Kilisut Harbor. Part of the commercial area of Samish Bay in the northern part of the state was also closed in August. September saw continued vigorous boom activity, closing Sequim Bay. Both Sequim Bay (5761μg) and Discovery Bay (3432μg) reached toxin levels in mid-September that were record setting. After the high toxin levels of August-September, most of Puget Sound began a downward trend during the last quarter of the year. However, the period continued to produce geoduck tract closures, accounting for eight closures, a third of the year's total.

Figure 7. Duration of Geoduck Tract Closures in 2000 Due to Biotoxin

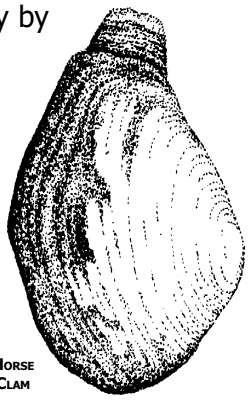


*** Tract not resampled to evaluate opening**

Recreational PSP Closures

North Puget Sound had the first PSP bloom for the year. It occurred in April in the Drayton Harbor area at the Canadian border. This area commonly blooms in the April to June time period, so this bloom was not unexpected. By mid May the bloom had expanded south to include Birch Bay. A second PSP bloom in the Bellingham area that began in August eventually closed all of Whatcom County in September. In May a bloom in the San Juan Islands began closing areas and by the end of June the entire county was closed. However, San Juan County did not repeat the high levels of July 1999, which exceeded 2,000μg. Skagit County bloomed later than the other northern counties. The Skagit blooms peaked in mid-August, closing the entire county. The highest toxin recorded in Skagit County was on Cypress Island at almost 2,000μg.

Central Puget Sound began to experience PSP activity in June, where a bloom closed areas around Bainbridge Island. By the first of July, the bloom had closed most of the east side of Kitsap County, with the highest toxin level of 1,413 micrograms recorded in Dyes Inlet. King County followed behind Kitsap, with a slightly delayed bloom that closed the east shore of the county by the middle of August. The highest King County toxin level peaked at the end of July, at about half of the Kitsap level, reaching nearly 700μg.

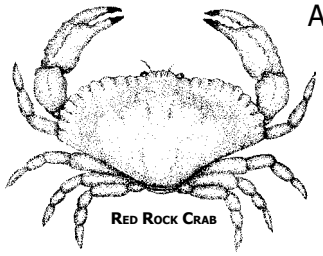


HORSE CLAM

The upper Olympic Peninsula area was slow to bloom this summer. Sequim Bay and Discovery Bay, areas that often have early blooms, did not reach closure levels until August. Both bays reached very high levels of toxin. The annual closure for the Strait of Juan de Fuca and the coastal beaches that usually is lifted by October 31 was extended due to the continued PSP activity in the Straits. Unlike the upper peninsula, Port Ludlow, to the south in Jefferson County, was closed in June due to PSP.

The area most active for PSP toxin in 2000 was south of the Tacoma Narrows. Levels reached almost 3,000µg in Central Carr Inlet in early August. Two weeks later, Wollochet Bay off Hale Passage, by Fox Island had a toxin level of 3,389µg. The following week, toxin levels in the north end of Carr Inlet exceeded 2,700µg. This was a massive and strong PSP bloom.

Mussels from Carr Inlet were implicated in nine cases of PSP illness at the end of August. Of the nine cases, seven were examined by a physician. Five of these were hospitalized; three required artificial respiration. Mussels from Horsehead Bay, where most of the illnesses originated, were tested and found to contain 13,769µg of PSP toxin. This toxin level has only been exceeded by the 1978 Whidbey Island bloom.



RED ROCK CRAB

At the time the Puget Sound blooms were gaining momentum in July, the coastal estuaries also had their own PSP blooms. While Grays Harbor and Willapa Bay were closed for recreational shellfishing due to toxic mussels, the toxin levels in the commercial oysters and clams were not high enough to close the commercial beds. These blooms continued on into November. On the outer coast, PSP levels in razor clams remained below the safety limit of 80µg.

The southern and western portions of South Puget Sound and Hood Canal are the only areas that did not experience a PSP closure. Locations with highest PSP levels reported in 2000 are listed in Figure 8.

DOH continued the Sentinel Mussel Monitoring Program as an early warning system for marine biotoxins in 2000. With assistance from local health jurisdictions, tribes, Adopt-a-Beach and other volunteers, 70 collection sites

Figure 8. Areas of Highest PSP Levels in 2000

Areas of Highest PSP Levels in 2000			
Date	**Harvest Area**	**Species**	*** Toxin Level**
08/27/00	Horse Head Bay (Carr Inlet)	Blue Mussels	13769
09/19/00	Sequim Bay State Park	Blue Mussels	5761
09/13/00	Discovery Bay Condos	Blue Mussels	3432
08/26/00	Cherry Cove (Carr Inlet)	Blue Mussels	3422
08/16/00	Wollochet Bay (Hale Passage)	Blue Mussels	3389
08/28/00	Kingston Marina	Blue Mussels	2989
08/02/00	Penrose Point (Carr Inlet)	Blue Mussels	2979
09/04/00	Burley Lagoon (Carr Inlet)	Blue Mussels	2936
09/14/00	Pitship Point (Sequim Bay)	Blue Mussels	2882
09/12/00	Cape George (Discovery Bay)	California Mussels	2680
09/12/00	Ediz Hook (Port Angeles Harbor)	Blue Mussels	2445
09/18/00	Protection Island Geoduck Tract #01000	Geoduck Clams	2320
09/18/00	Fort Flagler (Kilisut Harbor)	Blue Mussels	2276
08/23/00	Filucy Bay (Pitt Passage)	Blue Mussels	2010
08/15/00	Pelican Beach (Cypress Island)	Blue Mussels	1986
08/23/00	Sinclair County Dock (Sinclair Island)	Blue Mussels	1872
09/18/00	Jamestown Tract #00450	Geoduck Clams	1678
09/21/00	Carr Point (Discovery Bay)	Pacific Oysters	1618
08/28/00	Outside Minter Bay (Carr Inlet)	Blue Mussels	1539
08/23/00	Strawberry Island (Cypress Island)	Blue Mussels	1528
09/18/00	Mystery Bay (Kilisut Harbor)	Blue Mussels	1508
08/28/00	Minter Bay (Carr Inlet)	Blue Mussels	1467
10/18/00	Green Point Tract #11300	Geoduck Clams	1422
07/16/00	Silverdale (Dyes Inlet)	Blue Mussels	1413
08/16/00	Fox Island South Tract # 11260	Geoduck Clams	1403
08/28/00	Miller Bay (Port Madison)	Blue Mussels	1000

* Micrograms per 100 grams of shellfish meat tissue

Figure 9. Sentinel Biotoxin Monitoring Sites

were maintained and monitored biweekly to monthly. Figure 9 shows the sentinel biotoxin mussel collection sites used in 2000.

In addition to the sentinel mussel locations, commercial mussels were routinely monitored at the following locations:

- Westcott Bay, San Juan Island
- Penn Cove and Holmes Harbor, Whidbey Island
- Totten Inlet, South Puget Sound

Domoic acid is a naturally occurring toxin produced by species of microscopic marine diatoms of the genus *Pseudonitzschia*. The human illness known as amnesic shellfish poisoning (ASP) or domoic acid poisoning (DAP) is caused by eating fish, shellfish or crab containing the toxin. Symptoms include vomiting, nausea, diarrhea and abdominal cramps within 24 hours of ingestion. In more severe cases, neurological symptoms develop within 48 hours and include headache, dizziness, confusion, disorientation, loss of short-term memory, motor weakness, seizures, profuse respiratory secretions, cardiac arrhythmias, coma and possibly death. There is no antidote for domoic acid poisoning and the toxin is not destroyed by cooking.

ASP was first characterized in 1987 on the Atlantic coast of Canada. Domoic acid was first detected on the Pacific coast in California in the summer of 1991, when a number of pelican and cormorant deaths were linked to domoic acid in anchovies. In the fall of 1991, domoic acid was detected in razor clams off the coast of Washington. This discovery brought a premature end to the recreational razor clam harvest but not before several mild cases of ASP were associated with the consumption of razor clams.

Domoic Acid Closures

Domoic acid levels are measured using a laboratory technique called high performance liquid chromatography (HPLC). The level of domoic acid determined to be unsafe for human consumption is 20 ppm in molluscan shellfish and 30 ppm for Dungeness crab viscera. Historically, in Washington molluscan shellfish growing areas were closed at a level of 15 ppm to allow for the time lag between sample collection and reporting of test results. In 2000, due to improved communication and cooperation that resulted in a significant reduction in the time lag referenced above, the closure level was raised from 15 to 20 ppm for molluscan shellfish. The Dungeness

Figure 10. Areas of Highest Domoic Acid Levels

Areas of Highest Domoic Acid Levels in 2000			
Date	**Harvest Area**	**Species**	*** Toxin Level**
03/16/00	Kalaloch Beach South	Razor Clam	35
03/16/00	Kalaloch Beach North	Razor Clam	21
02/15/00	Twin Harbors Area G	Razor Clam	19
02/15/00	Twin Harbors Area CL	Razor Clam	14
01/07/00	Copalis Area XL	Razor Clam	12
03/04/00	Quinault Reservation B	Razor Clam	10
06/08/00	Twin Harbors Area XH	Razor Clam	10
10/15/00	Long Beach Area XA	Razor Clam	9
04/24/00	Copalis Area XK	Razor Clam	8
09/13/00	Mocrocks Area JC	Razor Clam	8
09/13/00	Mocrocks Area CR	Razor Clam	8
10/14/00	Copalis Area K	Razor Clam	8
10/14/00	Mocrocks Area MP	Razor Clam	8
10/15/00	Long Beach Area OY	Razor Clam	8
09/25/00	Copalis Area GS	Razor Clam	7
10/14/00	Mocrocks Area BC	Razor Clam	6
04/02/00	Long Beach Area E	Razor Clam	6
09/25/00	Mocrocks Area CP	Razor Clam	5
11/16/00	Long Beach Reserve	Razor Clam	4
03/04/00	Quinault Reservation C	Razor Clam	3
05/03/00	Quinault Reservation D	Razor Clam	3
09/27/00	Copalis Area QBR	Razor Clam	3
06/18/00	Penn Cove	Blue Mussel	2

** parts per million*

crab areas are closed when three of six individual crab viscera equals or exceeds 30 ppm.

Research shows that razor clams accumulate domoic acid in the edible tissue (foot, siphon and mantle) and are slow to rid themselves of the toxin. In Dungeness crab domoic acid primarily accumulates in the viscera.

In 1991 DOH began monitoring all major shellfish growing areas for domoic acid. To date, unsafe levels of domoic acid have only been detected in coastal razor clams and Dungeness crab. Unsafe levels have not been detected in other species of coastal shellfish, nor have they been detected in the coastal estuaries of Grays Harbor, Willapa Bay or the inland waters of the Strait of Juan de Fuca, the San Juan Islands or Puget Sound.

Approximately 118 crab and 1157 molluscan shellfish samples were tested for domoic acid in 2000. The year started with domoic acid levels in razor clams still on a declining trend, which began late in 1999. This was the result of the bloom that began in 1998, when toxin levels reached triple-digit numbers. Kalaloch Beach, which had reached an all time high of 295 ppm in November 1998, remained closed for the entire year in 1999 and the spring of 2000. By October 2000, the toxin levels in razor clams at Kalaloch, Long Beach, Twin Harbors, Copalis and Mocrocks dropped low enough to allow fall harvesting.

In June and July, a commercial razor clam harvest was possible on the Willapa Spits. However, there was a short interruption in the season when a sample exceeded the closure limit. Domoic acid tests of commercial Dungeness crab from the outside coast reflected the low levels found in the razor clams. One crab tested 1 ppm of domoic acid. All the other crab tested <1 ppm or No Toxin Detected (NTD).

In 2000, domoic acid was detected in a number of samples in blue mussels in the inland waters of Puget Sound. The toxin level ranged from <1 ppm to 2 ppm.

The highest domoic acid levels for the year are listed in Figure 10. For more information on PSP and domoic acid contact Frank Cox at (360) 236-3309.

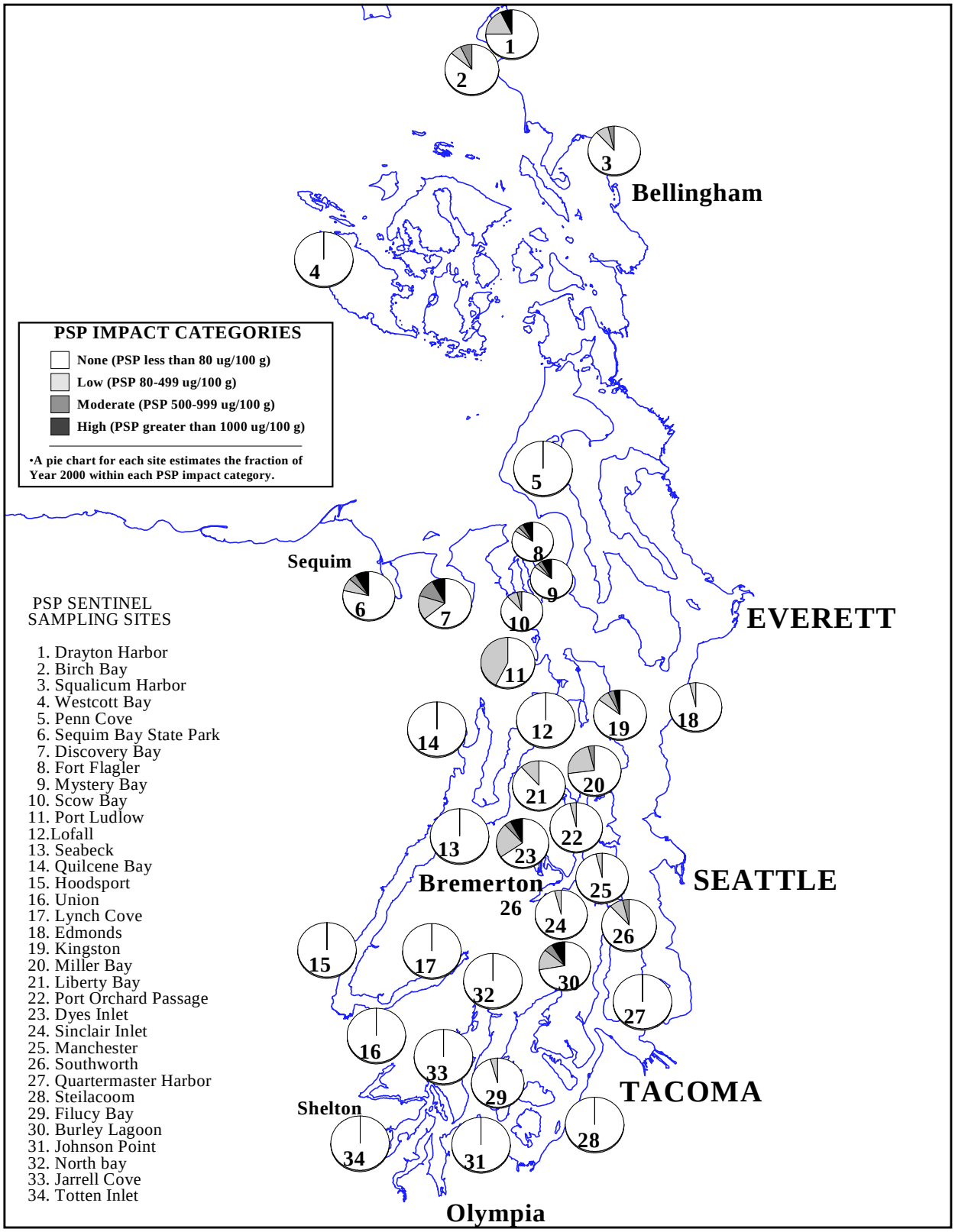
Summary of PSP Trends Over Time

Each year DOH analyzes spatial and temporal trends in PSP for PSAMP. In 2000 DOH recently examined PSP results from 34 sentinel mussel sites in Puget Sound and the straits of Juan de Fuca and Georgia. The analysis covered the period 1991 through 1999.

PSP results from samples collected in 2000 from each Sentinel site were sorted into impact categories. Fractions of impact categories for each station are shown in Figure 11 (the impact categories are defined in the legend). Twenty-one of the 34 PSP Sentinel sites had at least a minimal level of impact. Figure 12 ranks the areas according to a PSP

RAZOR CLAM

Figure 11. Summary of Paralytic Shellfish Poisoning (PSP) in Puget Sound Mussels.

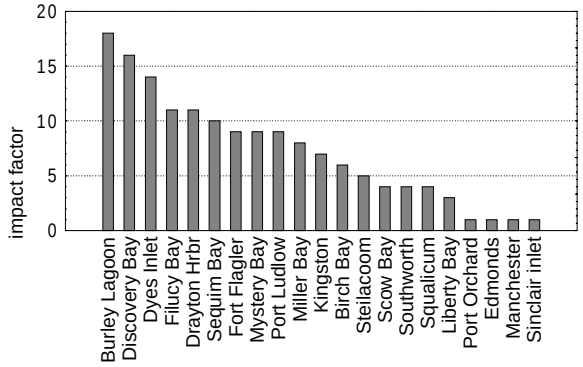


impact factor developed for PSAMP. Burley Lagoon ranked highest in PSP impact during 2000. Close behind were Discovery Bay and Dyes Inlet. Edmonds, Manchester, and Port Orchard (Sinclair Inlet) showed low impact.

There is little evidence of a positive link between human activity and PSP intensity. For example, 4 of 7 sites with high PSP activity were along the Strait of Juan de Fuca, a relatively isolated area. On the other hand, 3 of 6 sites with the lowest impact factors are in heavily urbanized basins (Squalicum Marina near Bellingham, Liberty Bay, and Sinclair Inlet).

The onset and duration of PSP episodes cannot be predicted due to interaction of poorly understood environmental factors. Therefore protection of shellfish consumers from PSP and other biotoxins require diligent monitoring. For more information on PSP trends contact Tim Determan at (360) 236-3311

Figure 12. PSP Impact Ranking



RECREATIONAL SHELLFISH PROGRAM

The goal of the Recreational Shellfish Program is to protect the health of recreational harvesters by providing them with sufficient information to make informed decisions about where and when it is safe to harvest shellfish.

Consolidated Contracts

Local health jurisdictions play an important role in protecting the health of recreational shellfish harvesters. All 12 Puget Sound counties received funding through their consolidated contract with DOH for recreational shellfish activities.

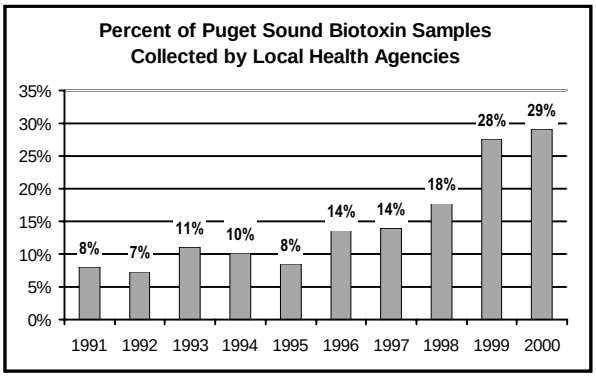
Local participation in biotoxin sampling is a key component of the contracts. The percentage of Puget Sound biotoxin samples collected by local health jurisdictions continues to increase each year and is now at 29% for 2000. Figure 12 shows the 10-year history of biotoxin sampling by local health agencies.

Local health agencies implemented a number of recreational shellfish education and outreach programs through consolidated contracts in 2000. This preventive approach to recreational harvester health promotion is a valuable aspect of the consolidated contracts/ local health partnership. Projects in 2000 include participation in community events and fairs, partnerships with local schools and state parks, educational talks, outreach to high risk harvester populations, newsletter production, and local shellfish telephone hotlines.

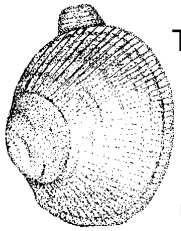
High Risk Harvest

DOH, Washington State Department of Fish and Wildlife, Puget Sound Water Quality Action Team, and Tacoma-Pierce County Health Department staff are continuing education programs for Asian and Pacific Islander (API) Communities. Focus remains on health risks for recreational harvesters and how to interpret health warning and regulatory information.

Figure 12. Biotoxin Samples Collected by Local Health Jurisdictions



Experience in this area allowed us to respond more effectively to the severe cases of PSP illnesses that occurred in Carr Inlet in the summer of 2000. It also demonstrates that, even with the best education programs, it is difficult to reach all harvesters and prevent them from harvesting in areas affected by biotoxins. However, the communication network developed by the API project certainly helped prevent further illnesses from occurring.



NATIVE LITTLENECK

To assess high risk harvest, DOH compares recreational harvester counts, calculated by the Department of Fish and Wildlife, with pollution data to identify high-risk beaches. Education and outreach efforts are then targeted at those areas to inform the public.

Sites Booklet

The revision of *Public Shellfish Sites of Puget Sound* (the "Sites Booklet") was completed in 1999. It is available for retail vendors through the Department of Printing. Vendors may order on-line at ww-application1.wa.gov/printers/ProductManualOrder.htm, or call (360) 753-6820.

The booklet is also in electronic format on the Internet at www.doh.wa.gov/ehp/sf/sf10maps.htm

Beach Classifications

Recreational shellfish beaches are classified by DOH as Unclassified, Approved, Conditional, and Closed. Further analysis of the harvest on Unclassified beaches will help guide classification and education efforts in 2001.

APPROVED

Approved beaches meet the sanitary standards of water quality and shoreline conditions for shellfish harvest.

CONDITIONAL

Beaches are classified Conditional if they reside within a commercial area with that classification. Conditional beaches close and open based on the same criteria as the commercial area, i.e. rainfall, seasonal marina usage, etc.

CLOSED

Closed beaches are those that either reside within a Prohibited or Restricted commercial area, or otherwise do not meet sanitary standards for water quality and shoreline conditions for shellfish harvesting.

Other reasons that a beach may be closed include the presence of *Vibrio parahaemolyticus*, sewage treatment plant outfalls, and emergency situations. DOH supplies signs reflecting situations that may affect public health. Figure 13 shows the recreational harvest signs provided by DOH.

Shellfish Listserv

A listserv is a computer system that you subscribe to by email. Once subscribed, you can send email to all subscribers on the list and you receive all email other members send to the list. The shellfish email Listserv is established to provide a communication link for a wide range of agency staff interested in shellfish issues. To subscribe to the list send an email to listproc@u.washington.edu with the words *subscribe shellfish* and then your first and last name in the body of the message. For example: Subscribe Shellfish Chris McCord. No subject is needed. For more information on recreational shellfishing contact Chris McCord at (360) 236-3312.

Figure 13. Current Recreational Shellfish Harvest Signs